REMARKS

This Request for Reconsideration is filed in response to the Office Action of July 26, 2004 in which claims 1, 7, 11 and 12 were rejected and claims 2-6 and 8-10 objected to.

I. Subject Matter of the Claims

The present invention relates to a method for bit swapping, wherein a stream of bits is modulated to obtain a stream of modulated symbols by mapping M-tuples (consisting of M consecutive bits of said bit stream) to modulated symbols, respectively, and wherein said mapping causes some bit positions in the M-tuple to be more error prone than others (so-called "weak" bit positions). This is for instance the case in 8-PSK modulation, where three bits are mapped to one 8-PSK symbol, and where the third bit position is more error prone than the first two bit positions. To avoid that important bits (e.g. USF bits in an EGPRS system) in said bit stream coincide with said error prone bit positions, prior art as already described in the opening part of the present application proposes to exchange (swap) more important bits (e.g. USF bits) of said bit stream that would otherwise coincide with the more error prone bit positions with less important ones (e.g. interleaved data bits).

The present invention addresses the case that the more and less important bits are *jointly* interleaved before said modulation and proposes a method, a system and a computer program that allow for the swapping of more and less important bits, take into account this joint interleaving and also account for different interleaving schemes and depths, so that swapping is only performed between bits that are located in the same burst and temporal diversity, as targeted by interleaving, is not affected. In particular, swapping can then be performed prior to interleaving, but of course, also swapping during or after interleaving is possible.

In terms of the method claim 1, the present invention comprises the following features:

A method for bit swapping, wherein

a) periodically I successive bits of a data packet that comprises K bits are mapped onto interleaved bit positions in I different bursts, respectively,

b) the mapping is in accordance with a predefined interleaving scheme and a selected interleaving depth I,

c) the method comprises the step of swapping the value of at least one bit that is associated with a respective first bit position m in said data packet with the value of a bit that is associated with a respective second bit position n in said data packet, and

d) said respective second bit position n is selected such that n > m holds and that the difference n-m is divisible by I.

Corresponding features are contained in independent system claim 11.

II. State of the Art

In the Office Action, only one document D1 is considered to be of relevance with respect to the patentability of the present patent application.

Summary of D1: US 6,259,744 B1

Prior art document D1 relates to a method and apparatus for mapping bits to an information burst in a digital wireless system.

According to a preferred embodiment of D1, a first group of bits, e.g. header bits, are interleaved to form a first group of interleaved bits. A second group of bits, e.g. data bits, are interleaved to form a second group of interleaved bits. The first and second groups of interleaved bits are then mapped to an information burst. The first and second groups of interleaved bits may be mapped to the information burst relative to a group of known symbols (a training sequence). A disadvantaged bit location, i.e. a bit location within the mapping having a relative high probability of incurring a bit error, is identified. A first group

bit from the first group of interleaved bits mapped to the disadvantaged bit location is re-mapped to the advantaged bit location while a second group bit from the second group of interleaved bits mapped to the advantaged bit location is re-mapped to the disadvantaged bit location (cf. col. 3, l. 4-22).

Examples for this re-mapping (or swapping) are given for different Modulation and Coding Schemes (MCS) of the Enhanced General Packet Radio Service (EGPRS) system with reference to Figs. 7 and 8, 9 and 10, and 11 and 12. For instance, in Fig. 7, a portion of an information burst 114 containing header bits (H, 100), USF bits (U, 102), stealing bits (S, 106), guard bits (G, 110), data bits (D, 104) and a training sequence (TS, 114) is shown. This information burst is constructed as follows:

Header bits are interleaved according to the interleaving scheme in step 1 of col. 7 (starting from l. 3), and data bits are interleaved according to the interleaving scheme in step 2 of col. 7 (starting from l. 11). The interleaved header bits and the interleaved data bits are then mapped to bit positions in the information burst 114, and similarly the non-interleaved USF and stealing bits are mapped to bit positions in said burst 114, as indicated by the mapping scheme in step 3 of col. 7 (starting from l. 20). It should be noted that this mapping is performed for four consecutive information bursts 114 at once, thus also implementing a partial interleaving for the USF and stealing bits over these four bursts. The header, USF and stealing bits, which are considered as important bits 112, are mapped close to the training sequence 116, to exploit the fact that bits transmitted near the training sequence undergo a smaller bit error rate. Furthermore, to avoid that important bits (header and USF bits) are mapped to more error prone bit positions that depend on the modulation scheme, after the mapping, a swapping of important bits (header or USF bits) with less important bits (data bits) is performed according to the swapping scheme of step 4 in col. 7 (starting from l. 38). The result of this swapping operation can be inspected in Fig. 8: none of the disadvantaged bit positions (marked with an X) is occupied by

an important (header or USF) bit anymore, but only by data bits.

III.Novelty and Non-obviousness

1. Independent Claims 1 and 11

Prior art document DI sets out from the same prior art that is already described in the opening part of the present invention, i.e. the problem of the existence of weak bit positions in a variety of modulation techniques as for instance 8-PSK or 16-QAM, in particular in an EGPRS system.

At least for the more important bits, this problem can be overcome by bit swapping, i.e. by avoiding the mapping of important bits to these weak bit positions. To further decrease the bit error rate of both the important and less important bits, D1 proposes to map the more important bits close to the training sequence in order to exploit the fact that the bit error rate, as a function of the bit position in a burst, decreases towards the position of the training sequence (see Fig. 4 of D1). A similar effect, namely the effect that error protection is strongest at the beginning and the end of the CCTrCH, is also exploited by a preferred embodiment of the present invention by swapping the important bits with less important bits at the beginning and the end of the CCTrCH (see claim 10 of the present invention).

Nevertheless, D1 is not suited to anticipate the subject-matter of independent claims 1 and 11. The prior art as stated in the opening part of the present invention and disclosed in D1 addresses only the case that a burst has already been constructed by mapping interleaved data bits and interleaved or non-interleaved header and/or USF bits to bit positions of this burst. It is then easy to determine the weak bit positions and to perform the swapping of the according bits to ensure that header and/or USF bits are not mapped to weak bit positions.

In contrast, the present invention considers the case where data bits and header/USF bits are contained in a data packet and *then jointly interleaved* to a plurality of bursts according to a predefined interleaving scheme and a selected interleaving depth. This is reflected by features a)-c) of claim 1 of the present invention.

D1 discloses feature a) and b), because 1=4 successive bits (header bits) of a data packet (the RLC/MAC header) that comprises K=96 bits are periodically mapped onto interleaved bit positions in 1=4 different bursts (the interleaved header bits are mapped to four information bursts 8=0,1,2,3, see step 3 of col. 7 starting from l. 20) according to a predefined interleaving scheme (see step 4 in col. 7 starting from l. 3) and a selected interleaving depth (1=4, which can be deduced from the interleaving scheme in step 1).

However, D1 does not disclose feature c): According to step 4 of col. 7 (starting from l. 38), the value of at least one bit (for instance the interleaved and mapped header bit at position i= 167 as indicated by the fourth swap operation in step 4 of col. 7, which is located seven positions left from the training sequence T5 116 in Fig. 7) that is associated with a respective first bit position m in said data packet (as said data packet is identified as said RLC/MAC header, said first bit position m is the bit position in the RLC/MAC header where the interleaved and mapped header bit was originally located) is swapped with the value of another bit (the interleaved and mapped *data* bit at position i=153, as indicated by the double arrow in Fig. 8 that connects position i=167 and i=153), but not with a bit **that is associated with a respective second bit position n in said data packet** (as said data packet is the RLC/MAC header and the data bit is not associated with a position in said RLC/MAC header). This is due to the fact that, according to step 4 and Fig. 8, header/U5F bits are only swapped with data bits, because it shall be avoided that header/USF bits are mapped to disadvantaged bit positions (see col. 7, l. 54-55). For feature c} to be fulfilled, thus a bit associated with a respective first bit position m in said RLC/MAC header would

have to be swapped with a bit that is associated with a respective second position n in said RLC/MAC header, which is not possible because the header bits are swapped with data bits only, which are not associated with any bit position in said RLC/MAC header at all.

As feature c) is not disclosed in D1, also feature d) can not be disclosed therein, as the determination if a difference between the positions m and n is divisible by the interleaving depth I can not be performed when the position n is not defined. This feature d) however ensures that the swapping of bits only is performed within a burst to preserve the temporal diversity that is targeted by interleaving, even when different interleaving schemes and interleaving depths I are used.

The subject-matter of the independent claims 1 and 11 as presently on file thus should be considered novel with respect to D1 and withdrawal of the rejection thereof on that ground is requested.

Although an obviousness rejection has not been asserted against independent claims 1 and 11, applicant would like to point out the following:

D1 only discloses to swap bit positions in a burst that has been constructed after interleaving (of the data and header bits). There is thus no hint that bit swapping could also be performed *before or during* interleaving.

D1 discloses that bit swapping is independent of the used interleaving algorithm (d. col. 7, l. 5). This is due to the fact that the interleaved bits are mapped to the information bursts *after interleaving.* For this information burst, then a fixed bit swapping scheme is presented. There is thus no trigger for a skilled person to deliberate that the bit swapping should depend on the interleaving depth, when joint interleaving of more and less important bits is performed and swapping is only desired within a burst.

D1 only implicitly discloses that bit swapping is performed within a burst (see e.g. Fig. 8, wherein the double arrows indicate which bits are swapped, and where bit swapping is then obviously restricted to bits within the same burst). D1 discloses no reasoning for this approach.

D1 discloses the swapping of interleaved bits that stem from different source data structures. The interleaved data bits stem from a data packet, the interleaved header bits stem from a header, and the non-interleaved USF bits stem from a USF packet. After interleaving, the interleaved data and header bits and the non-interleaved USF bits are mapped to the four information bursts, and then bit swapping is performed. Setting out from D1, it is thus impossible to provide a condition for burst-intern bit swapping that is related to the positions of the swapped bits before their interleaving, because in D1, the swapped data bits before interleaving are not contained in the same data structure and thus their positions in their respective data structures can not be exploited.

Considering these observations, it can readily be seen that the subject-matter of independent claims 1 and 11 would not be rendered obvious by the disclosure of D1.

<u>2. Dependent Claim 7</u>

As dependent claim 7 depends on dependent claim 4, which is considered to be novel and inventive by the Examiner, it is assumed that also dependent claim 7 should be novel. Withdrawal of the novelty rejection of claim 7 is requested.

<u>3. Dependent Claim 12</u>

As independent claim 1 has been shown above to be both novel and inventive, dependent claim 12 should fulfil these criteria as well.

The objections and rejections of the Office Action of July 26, 2004, having been obviated by amendment or shown to be inapplicable, withdrawal thereof is requested and passage of claims 1-12 to issue is solicited.

Respectfully submitted,

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